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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Hye-Yeon Kim

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STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

EXAMINER

BLOOM, NATHAN J

ART UNIT

PAPER NUMBER

2624

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/717,621	Applicant(s) KIM ET AL.	
	Examiner NATHAN BLOOM	Art Unit 2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 March 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) 1,3-25,27-29,31-33,35,36,38-61,64-68 and 70-75 is/are pending in the application.
4a) Of the above claim(s) 12-24,47-59 and 72 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-6,9,10,25,28,29,32,33,36,38-41,44-45,60,61,66-68,71 and 73-75 is/are rejected.
- 7) ☒ Claim(s) 7-8,11,27,31,35,42,43,46,64,65,70 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Applicants' response to the last Office Action, filed on March 24th, 2009 has been entered and made of record.

Response to Arguments

1. Applicant's arguments regarding the 35 USC 101 rejection of claims 36, 38-46, 60-61, 64-68, and 70 were persuasive, and the 35 USC 101 rejection of these claims has been withdrawn. Applicant has argued that by definition (applicant cited a reference with a particular definition of the term pixel) a pixel implies a statutory device (see page 1 of Applicant's remarks).
2. Applicant's arguments with respect to the newly amended claims 1, 33, 36, and 68 have been considered but are moot in view of the newly adjusted rejection of these claims. Please see the adjusted grounds of rejection below for how the newly amended portion were interpreted in view of the art.
3. In response to applicant's arguments beginning on page 3 of the remarks against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Please see the rejection of the claims below wherein each reference has been tied together with a 35 USC 103 motivation. Examiner has admitted the deficiency of each reference

Art Unit: 2624

in view of the limitations of the current application and has included a motivation to combine the previous reference with each proceeding reference.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1, 3-6, 25, 29, 36, 38-41, 60-61, 71, and 73-74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dougall (US 5019903) in view of Greggain (US 6219464), and in further view of Bretl (US 5894329).

Instant claim 1: An apparatus for enhancing the quality of a reproduced image comprised of a plurality of pixels having original pixel values corresponding to the image, comprising:

a vertical area existence determination unit which determines whether or not an edge included in an input pixel selected from the plurality of pixels belongs to a vertical area;
[Greggain has taught in figures 1-3, 10, item 104 of figure 8, and column 5 line 45 to column 6 line 25, a method of directional interpolation for scaling an image based on the measurement of vertical and diagonal (slant line) absolute differences (the measure of possibility) of the pixels in rows above and below the input pixel (pixel to be interpolated), but since Greggain teaches

Art Unit: 2624

scaling of an image the input pixel (pixel to be interpolated) does not have a previous (original) pixel value. However, Dougall discloses a method of directional interpolation based on pixels of even and odd fields (interlaced video frames) wherein the input pixel (pixel to be interpolated) had a previous value. Therefore, both Dougall and Greggain have taught the directional interpolation of image data. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the directional interpolation method of video images taught by Dougall with the directional interpolation method taught by Greggain to improve the accuracy of the directional interpolation. Additionally, Greggain's method allows for fractional resizing of the image (column 1 lines 60+).]

a slant line possibility determination unit which determines whether or not there is a possibility of the edge forming a slant line when the edge is determined to not belong to the vertical area; [*Greggain teaches in figures 1-2, column 5 line 45 to column 6 line 25, the taking of the absolute difference (the measure of possibility) of the pixels in the slant line and vertical directions (Figure 10 and 104 of Figure 8).*]

a direction determination unit which determines a direction of the slant line when the edge is determined to possibly form the slant line; and [*Greggain teaches in column 6 line 25 to column 7 line 59, the determination of the edge direction based on the comparison of absolute values to particular thresholds (Figure 10 and 104 of Figure 8).*]

an interpolation unit which calculates an interpolated pixel value for the input pixel based on the determination results provided by the vertical area existence determination unit, the slant line possibility determination unit, and the direction determination unit; and [*Greggain teaches*

Art Unit: 2624

in column 7 lines 25-32 the interpolation in a determined direction (vertical or one of the oblique angles), based on the vertical/slant line possibility determination. Also see Figure 8, wherein Greggain teaches that the interpolated value is output as w (item 106 of figure 8).]

an adjusted pixel value calculation unit which compares the interpolated pixel value with an original input pixel value and adjusts the interpolated pixel value by designating one of the original input pixel value or the interpolated pixel as an output pixel value based on the comparison result. [Greggain and Dougall have taught a method of de-interlacing, but do not teach the comparison of the interpolated pixel value with that of the original (or pervious/next pixel). However, Bretl has taught a de-interlacing method in column 5 lines 18-40 that compares the interpolated pixel value to the previous and next (temporally) pixel, in order to determine the proper pixel value based on the amount of motion. Also, Bretl has taught in column 5 lines 4-17 the weighting of the interpolated pixel value or the original pixel value such that the output value can be all original pixel value or all interpolated pixel value dependent on the comparison result (motion value determination). Additionally, Examiner has interpreted the original pixel value as the value of the pixel in the same position that preceded the currently interpolated pixel value, because the current claim language does not require that the original pixel value be of the same image. It would have been obvious to modify the de-interlacing teachings of Dougall and Greggain by adding the previous/next pixel comparison step as taught by Bretl to reduce the amount of pixel error caused by motion between frames, as taught by Bretl.]

Art Unit: 2624

Instant claim 3: The apparatus of claim 1, wherein the vertical area existence determination unit determines that the input pixel exists in the vertical area when a difference (a) between values of upper and lower pixels, vertically adjacent to the input pixel, is smaller than a predetermined threshold value and determines that the input pixel exists in the slant line area when the difference (a) is greater than the predetermined threshold value. *[See column 6 lines 25-40 (see Figures 7A and 7B for the flowchart) of Greggain, wherein if the vertical difference is below the threshold (threshold is the lowest of the difference of the 2 oblique directions) the vertical direction is chosen, and if the vertical difference is greater than the threshold (minimum oblique difference) then the oblique (slant) direction is chosen.]*

Instant claim 4: The apparatus of claim 1, wherein the slant line possibility determination unit determines that the edge included in the input pixel may have a slant-line shape when a predetermined number of values among differences between values of two pixels, arranged at each side of the upper pixel, and values of their vertically corresponding pixels are not smaller than the predetermined threshold value and are obtained using two pixels located at one or the other side of the upper pixel and their diagonally corresponding pixels. *[See column 6 lines 25-40 (see Figures 7A and 7B for the flowchart) of Greggain, wherein either of the two pixels in the top row can be considered the upper pixel. If at least one of the oblique (slant) direction differences is below the threshold (threshold is the difference in the vertical direction) the interpolation is performed in the oblique direction. As can be seen in figures 1-3 the pixels are arranged at either side and differences are of the diagonally corresponding pixels.]*

Art Unit: 2624

Instant claim 5: The apparatus of claim 1, wherein:

an upper pixel is arranged above in an upper position vertically adjacent to the input pixel, [*See figure 4 of Dougall, wherein the pixel to be interpolated is the X pixel.*]

a lower pixel is arranged in a lower position vertically adjacent to the input pixel, [*See above.*]

a first pixel pair is horizontally arranged at one side of the upper pixel, [*See above.*]

a second pixel pair is horizontally arranged at the opposite side of the upper pixel, [*See above.*]

a third pixel pair is horizontally arranged at one side of the lower pixel and, with respect to the input pixel, arranged diagonally to the first pixel pair, and [*See above.*]

a fourth pixel pair is horizontally arranged at the opposite side of the lower pixel and, with respect to the input pixel, arranged diagonally to the second pixel pair, and [*See above.*]

the slant line possibility determination unit determines that the edge included in the input pixel may have a slant-line shape when:

differences between values of each of the first pixel pair and values of a diagonally corresponding pixel of the third pixel pair, are smaller than the difference between the upper pixel and the lower pixel, and [*See below.*]

Art Unit: 2624

the difference between values of each of the first pixel pair and values of a diagonally corresponding pixel of the third pixel pair, are also smaller than differences between values each of the second pixel pair and values of the respective pixels of the fourth pixel pair. [Greggain teaches in column 6 lines 25-40 (see Figures 7A and 7B for the flowchart), wherein either of the two pixels in the top row can be considered the upper pixel. If at least one of the oblique (slant) direction differences is below the threshold (threshold is the difference in the vertical direction) the interpolation is performed in the oblique direction. Also, Greggain teaches in column 6 line 25 to column 7 line 40 (figures 1-3 of Greggain, diagonally corresponding differences) that the corresponding diagonal direction is selected based on being smaller than the other. However, Greggain only teach the differencing between single pixels and not pairs of pixels. Dougall teaches (see figure 4) the differencing of opposing pixels pairs, and the positioning of upper and lower pixels. As per the rejection of instant claim 1 it would have been obvious to one of ordinary skill in the art to combine the teachings of Greggain and Dougall to modify the video de-interlacing interpolation method using the thresholding and directional determination method of Greggain (comparing slant and vertical directions to thresholds, see the rejection of claim 1). Furthermore, as taught by the Dougall the upper and lower pixels (see figure 4) are the vertical difference and the diagonal pixel differences are the corresponding adjacent (to upper/lower pixel) and diagonally opposing (with respect to pixel to be interpolated) pairs of the pixels. Thus, in view of Dougall the oblique differences are pairs of pixel differences.]

Instant claim 6: The apparatus of claim 1, wherein the direction determination unit comprises:

Art Unit: 2624

a direction estimator which estimates the direction of the slant line when it is determined that there is a possibility of the edge having a slant-line shape; and [*See rejection of instant claim 1 wherein direction is selected/estimated based on minimum value criteria.*]

a precision determiner which determines precision of the estimation. [*Greggain teaches a measure of precision in lines 14-25 of column 7. The particular section states that there is a minimum allowable difference (between the magnitude of the differences of the oblique directions) that must be met else the vertical direction is chosen. This threshold is a determination of whether or not there is minimal difference (possibly due to just noise) wherein when the difference between is lower than the minimal threshold the precision of this direction (oblique) decision is low and thus the direction defaults to a vertical direction.*]

Instant claims 25, 60, and 64 are encompassed by the limitations of instant claims 1, 4, 6 and 7 and as per rejection of instant claims 1, 4, 6, and 7 the apparatus of claim 25 and the method of claims 60 and 64 have been disclosed since the disclosed apparatus performs the method (See figures 7A&B of Greggain show method flowchart and corresponding disclosure in specification.).

Instant claims 29 and 61 are encompassed by the limitations of instant claims 1, 5 and 6 and as per rejection of instant claims 1, 5, and 6 the apparatus of claims 29 and the method of claims 61 have been disclosed since the disclosed apparatus performs the method (See figures 7A&B of Greggain show method flowchart and corresponding disclosure in specification.).

Art Unit: 2624

Instant claims 36 and 38-41 are encompassed by the limitations of instant claims 1 and 3-6 and as per rejection of instant claims 1 and 3-6 the method of claims 36 and 38-41 have been disclosed since the disclosed apparatus performs the method (See figures 7A&B of Greggain show method flowchart and corresponding disclosure in specification.).

Instant claims 71 and 73-74 encompass the computer readable media that perform the method of claims 36 and 60-61. As per rejection of instant claims 36 and 60-61 the method has been disclosed. However, Dougall and Greggain do not disclose the storing or implementation of the methods in software. Examiner takes Official Notice that it was notoriously well known to one of ordinary skill in the art at the time of the invention to implement interpolation methods to be performed by a computer. Furthermore, the implementation of such a method in software allows for easy manipulation of the method, and the use of a cheap, highly available, and portable multi-purpose apparatus (computer).

6. Claims 10, 33, 45, 68 and 75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dougall and Greggain as applied to claims 1 and 6 above, and further in view of Westerman (US 6262773).

Instant claim 10: The apparatus of claim 1, wherein the interpolation unit obtains the interpolated pixel value using values of upper three cells and lower three pixels with respect to the input pixel, which belong to the same row as the input pixel but different columns from one another, when the edge included in the input pixel is determined to belong to the vertical area,

Art Unit: 2624

and obtains the interpolated pixel value using the values of four pixels diagonally adjacent to the input pixel when the edge included in the input pixel is determined to belong to the slant line area. *[Dougall and Greggain have taught the use of 2 upper and 2 lower pixels for interpolation as can be see in figure 1 of Greggain, but do not teach the use of more than 2 pixels in a row or the interpolation of more than 2 pixels (4 in particular) in the slant direction. However, the use of four or more pixels in a row and the interpolation of 4 or more pixels has been taught by Westerman in figures 8-17 and column 9 line 35 to column 10 line 57, which describes the pixel to be interpolated as the X and the pixel to be used for interpolation as the slant selection as can be clearly seen figure 17. It would have been obvious to one of ordinary skill in the art to combine the teachings of Westerman with Dougall and Greggain to reduce the error of the interpolated value by increasing the number of data-points used for edge determination and interpolation.]*

Instant claims 33 and 68 are encompassed by the limitations of instant claim 10 and as per rejection of instant claim 10 the apparatus of claim 33 and the method that the apparatus performs as is described in claim 68 have been disclosed (See figures 7A&B of Greggain).

Instant claim 45 are encompassed by the limitations of instant claim 10 and as per rejection of instant claim 10 the corresponding method of claim 45 have been disclosed since the disclosed apparatus performs the method. Furthermore, figures 7A&B of Greggain show the method flowchart.

Art Unit: 2624

Instant claim 75 is the computer readable medium that performs the method of claim 68. As per rejection of instant claims 68 and 71 the method and corresponding CRM have been disclosed.

7. Claims 9, 28, 32, 44, and 66-67 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dougall and Greggain as applied to claims 1 and 3-4 above, and further in view of Yoo (US 2003/0112369).

Instant claim 9: The apparatus of claim 6, wherein the precision determiner determines the estimation of the direction of the slant line to be precise when the direction estimator estimates the slant line to be tilted rightward (or leftward), the difference a between the values f and k of the upper and lower pixels, a difference between k and a value g of an upper right pixel, a difference between g and a value j of a lower left pixel, and a difference between f and j are not smaller than a predetermined threshold value. [*Dougall and Greggain teach the differencing of upper and lower pixels, but do not teach the use of a threshold value for comparing these absolute values to in order to measure the precision of the directional choice. However, Yoo in paragraph 0085 teaches the comparison of the directional differences to a threshold value (TH_VAL) and if the values are less than the threshold then the chosen leftward/rightward (positive/negative slope) directionality are considered imprecise at which point a reevaluation of the directionality is performed.*]

Art Unit: 2624

Instant claims 28, 32, 44, and 66-67 are encompassed by the limitations of instant claims 3-4 and 9 and as per rejection of instant claims 3-4 and 9 the apparatus of claims 28, 32 and the method of claims 44 and 66-67 as performed by the disclosed apparatus have been disclosed.

Allowable Subject Matter

8. Claims 7-8, 11, 27, 31, 35, 42-43, 46, 64-65, and 70 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. (Note: Reasoning noted in prior office action.) Claims 11, 35, 46, and 70 provide further details of the previous pixel comparison and how it affects the determination of the interpolation value that is not in the known or cited prior art.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

Art Unit: 2624

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Contact Information

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nathan Bloom whose telephone number is 571-272-9321. The examiner can normally be reached on Monday through Friday from 8:30 am to 5:00 pm (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Bella, can be reached on 571-272-7778. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Matthew C Bella/

Supervisory Patent Examiner, Art Unit 2624